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Department of Health

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SPECIAL BULLETIN NO. 16. **JULY, 1919.**

THE HOUSE-FLY---
CARRIER OF DISEASE

Published at Helena, by the State Board of Health.

You cannot maintain an A1 nation from a C3 population. National efficiency depends upon national health.—David Lloyd George.

This Bulletin will be mailed to any person in Montana upon request, mailed to the Secretary of the State Board of Health at Helena.

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These and the Monthly Bulletin of the Montana State Board of Health sent to any citizen of the state on request.

Address W. F. COGSWELL, M. D., Sec'y.
State Board of Health,
Helena, Montana.

THE HOUSE-FLY—CARRIER OF DISEASE*

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As an enemy of mankind, the house-fly, or typhoid fly—carrier of disease—is the most dangerous animal that exists. It has carried death to more human beings than have all the beasts of prey and poisonous reptiles put together.

It carries the germs of disease on its feet and in its sucking-stomach and distributes them wherever it walks, regurgitating them through its proboscis on articles of food, and depositing them everywhere in its excrement—the so-called "fly specks."

Diseases Commonly Carried by Flies

A disease which it commonly carries is typhoid fever. This disease is also frequently gained from polluted water or milk and from other substances, but the house-fly is responsible for many thousands of cases. Typhoid is a germ disease. Four per cent. of the persons who have had typhoid become chronic carriers of the germs and give them off in their feces for months and sometimes years. From such feces flies carry the germs to exposed food. Typhoid germs will remain alive on various substances for many days, and may remain alive in butter for some months.

The house-fly also carries the germs and causes the spread of infantile diarrhea. Antifly work carried out in a district in New York City by Armstrong and in Richmond by Levy have greatly reduced the death-rate from this disease.

Flies are greatly attracted to tuberculous sputum and can carry and distribute the germs of tuberculosis for several days.

Flies carry the virulent germs of anthrax, or malignant pustule. They also carry the eggs of parasitic worms and the germs of other diseases.

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* This pamphlet is one of a series on public health, prepared by the Council on Health and Public Instruction of the American Medical Association. Other pamphlets can be secured from the Secretary of the State Board of Health or from the Council on Health and Public Instruction, American Medical Association, 535 North Dearborn Street, Chicago.

Dr. Stiles of the U. S. Public Health Service and of the Hookworm Commission, after working for several years in the South, states that the story of the danger of disease from the house-fly has been only half told. Dr. Levy, health officer of Richmond, Va., concurs in this opinion.

Breeding Places

Flies will breed in almost any fermenting organic matter. In cities probably most of them breed in horse-manure at the stables. In the country and in small villages, the more or less primitive privies and the deposits of nightsoil that exist there are the breeding places of quantities of flies.

Fig. 1.—Larva, puparium and adult of housefly.

It may be stated here that flies which breed in privies are more dangerous than flies which breed in piles of horse-manure, since they are direct carriers of disease germs which are to be found in human feces; whereas if they are bred in piles of horse-manure the germs which they get there are not apt to be injurious to human beings, and it is necessary for them subsequently to visit exposed excrement or substances that have been contaminated by it before they get the most dangerous germs.

They will breed in the manure of other animals—not frequently in cow droppings, since these dry up

so rapidly, but in pig-manure and that of other animals when brought together in a mass.

They will breed also in garbage of all kinds, even in old cloth and paper when damp and fermenting; also in brewery waste or in decaying vegetables, in fact in all sorts of animal and vegetable refuse.

Life History

Each female fly may lay from 120 to 150 eggs at a time. She begins laying from a week to ten days after appearing, and she may at intervals of ten days lay three or four such batches of eggs. The eggs are minute, white, elongate, as shown in Figure 3.

Fig. 2.—Head of house-fly seen from the side. (Courtesy of the National Geographic Magazine.)

In warm weather the eggs hatch in from eight to ten hours.

From each egg hatches out a slender, white maggot, which burrows into the manure or other breeding substance, and which in warm weather grows rapidly and may reach full-size in midsummer in five days. These maggots are active and move about from place to place in the manure pile. When full-grown they migrate to the bottom of the pile or to its sides, and when the pile is placed on the bare ground they will sometimes burrow into the ground itself. There they transform to puparia (Fig. 5)—small, oval, brownish

objects, from which after four or five days the adult flies issue.

The adult flies, having once issued from the puparia, do not grow. Some true house-flies are smaller than others because the substance in which they breed was too dry or too scanty, but all true house-flies are about the same size. The very small flies which one sees are of other species.

The adult female fly does not begin to lay eggs until a week or more after issuing. It is a strong flier and will migrate to considerable distances in search of food

Fig. 3.—Greatly enlarged view of house-fly's eggs.

or fresh place in which to lay its eggs. It will probably not fly very far if food is near, but it has been shown that individual flies have migrated to distances considerably over half a mile, and in one instance at least, to a distance of a mile.

Breeding Time of Flies

Flies will begin to breed in the spring as soon as the days begin to be consistently and consecutively warm. They will continue to breed until well on into the autumn. The number of generations will depend on the length of the consistently warm season, and there

may be, for example, in such a climate as that of Washington, nine or even more generations each year. Further south where the summer is longer, and particularly where the climate is moist, there may be more generations than this. When cold weather comes breeding stops, and adult flies pass the winter hidden away in cracks and crevices to emerge the following spring to start a new generation.

It is supposed by some that they also pass the winter in the puparium stage in or beneath manure heaps, but this point has not as yet definitely been settled.

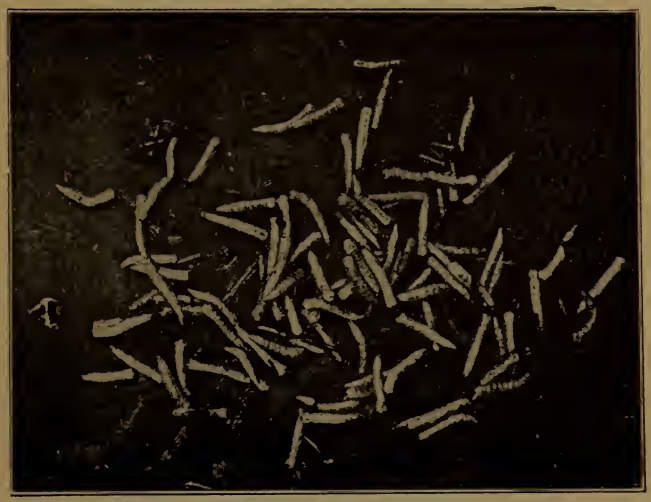

Fig. 4.—Larvae or maggots of house-fly.

With nine generations, if all offspring were to survive, and even should each female fly lay but one batch of eggs instead of three or four, the descendants from a single overwintering female by September 10 would number 5,598,720,000,000.

A well-infested manure-pile may contain from 1,200 to 2,000 maggots per pound of manure, but all parts of a pile are not equally heavily infested, and in large piles maggots will be found only in certain places and especially in the new accumulations and around the edges.

The "specks" on a window or a mirror, or a white wall, or a picture frame, left by flies are of two kinds.

The smaller, rounded, darker specks are the excrement, and, depending on food, a fly may make from fifty to a hundred of these specks a day. The other specks, which are larger, lighter in color and of not so regularly rounded outline, are caused by the regurgitation of the liquefied food from the sucking-stomach. Both these vomit spots and these excrement spots may contain living virulent germs, and it is worthy of note that one fly will suck up the vomit spot of another fly, thus infecting itself if it were not previously infected.

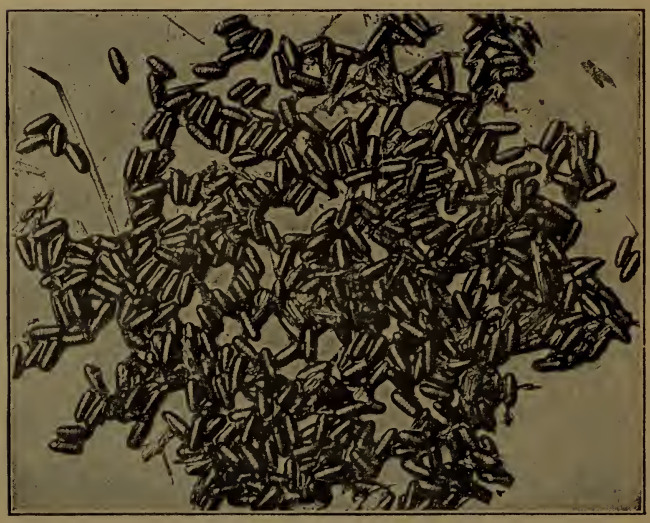

Fig. 5.—Puparia of house-fly.

Measures of Control

It is perfectly obvious that, in a community, control measures must be undertaken by concerted action. In isolated farmhouses or cottages individual families should be able to control the pest of flies. In communities there should be organization, followed by a thorough campaign of education in which, by all means, the schoolchildren should be taught everything possible about the house-fly. It goes without saying that every fly killed, no matter in what stage, is a gain, but it is much to be doubted whether any striking diminution in the number of flies can be brought about by a campaign against adult flies in midsummer such as has been

carried on in a number of cities recently, usually under the auspices of some newspaper or some civic body with prizes awarded to the child who turns in the greatest number of dead flies. The means productive of best results should be directed toward possible breeding-places, especially in the early part of the season. A clean-up day or a clean-up week, such as that carried on in the city of Washington is an excellent idea.

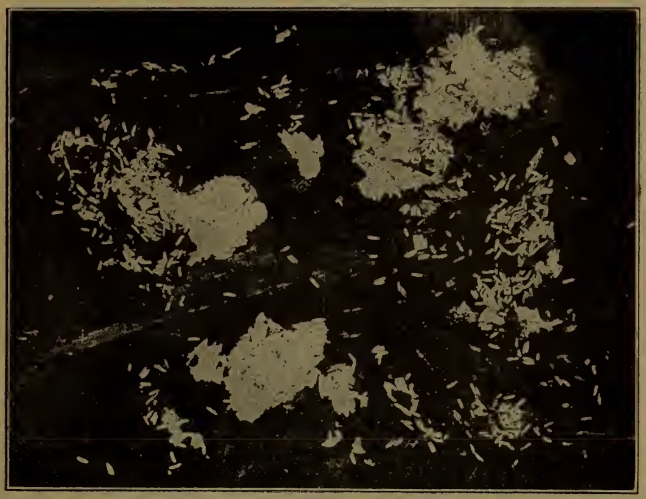

Fig. 6.—Patches of eggs of house-fly on manure.

Destruction of the Adult Flies

There are very many different kinds of fly-traps and "fly-swatters" on the market, nearly all of them good. The use of poisonous fly-papers, however, is on the whole to be avoided on account of the possible danger of poisoning children. The sticky, non-poisonous fly-papers are to be preferred.

Although there are so many excellent and cheap fly-traps to be bought, it may be worth while to describe how a large-sized and effective one may easily be constructed.

Take two pieces of board one inch thick and about a foot square; tack them together; saw them round, and in the center saw a hole 8 inches in diameter. Then separate the boards, and into one fit a funnel-

shaped piece of wire screen about 10 inches high, fastened to the board with tacks driven on the inside of the round hole and fastened together funnel-shaped with a strand of the wire selvage. Leave a small hole, large enough to admit a lead pencil, at the apex of the funnel, for the flies to creep through. Then tack a piece of wire netting 18 inches wide to the outside circumference of each of the round boards, with the funnel-shaped wire on the inside. Fasten the outside

Fig. 7.—Colonies of bacteria on a gelatine plate over which a fly has walked.

of the wire again with the selvage wire. On the top tack a piece of wire screen in such a way that it may readily be removed to empty out the flies. Then outside of the trap nail a few laths to make it firm. Make feet for the trap by screwing into the bottom piece four wire coat-hangers about five inches high. Beneath the lower orifice place a plate with some attractive bait —sweetened water, or beer and molasses, or scraps of decaying banana.

The use of formaldehyd has been found by many to be effective. Two ounces of 45 per cent. formaldehyd should be placed in a saucer with 2 ounces of sugar and 10 ounces of water. This should be left overnight in a fly-infested room, *care being taken that no other liquid is standing in the room.* Flies, becoming thirsty, will drink the mixture and will die.

Privies

An unprotected privy is a source of the greatest danger, largely through the fact that flies visit it, breed in it and carry disease germs from it everywhere. No

Fig. 8.—A source of millions of flies.

application to the privy contents can be perfectly effective. Fly-maggots will burrow through a considerable covering of earth. People cannot be relied on to apply lime or kerosene. The bucket method, the contents of which are removed daily, is all right, provided the place to which the contents of the buckets are removed can be supervised and treated daily. The screening of privies to prevent the access of flies to feces is a good measure, but flies will enter on the opening of the best screen door.

Following the discovery by Stiles of the easy demonstration, by the finding of certain spores in the excreta of children and the consequent deduction that

those individuals in whose excrement these spores are found must have eaten food contaminated by other excrement, and the subsequent demonstration that a large percentage of the children in a certain community contained these spores, this community has imposed a privy tax, from the proceeds of which the community itself superintends the daily removal and care of human feces. The mothers became so horrified at the thought of their children indirectly eating of this substance that they demanded action on the part of the community officials.

Fig. 9.—A back yard where dangerous flies are breeding.

The privy should be cared for by officials of the community.

Receptacles for and Removal of Stable-Manure

It is possible, in many instances, to build a bin or closet, or, with small stables, to prepare a tight barrel of large size into which all stable-manure is placed daily, and if the contents of the bin, closet or barrel are removed at intervals, say once a week, and the

manure is spread, fly-breeding in this substance can be reduced to a great extent. This of course requires community action in the case of cities, towns and villages, and in order to make the operation of such a regulation perfect it is important that the floors of all stables should be made of concrete. Excellent results have been gained in many places by the administration of an ordinance compelling such disposal of stable refuse.

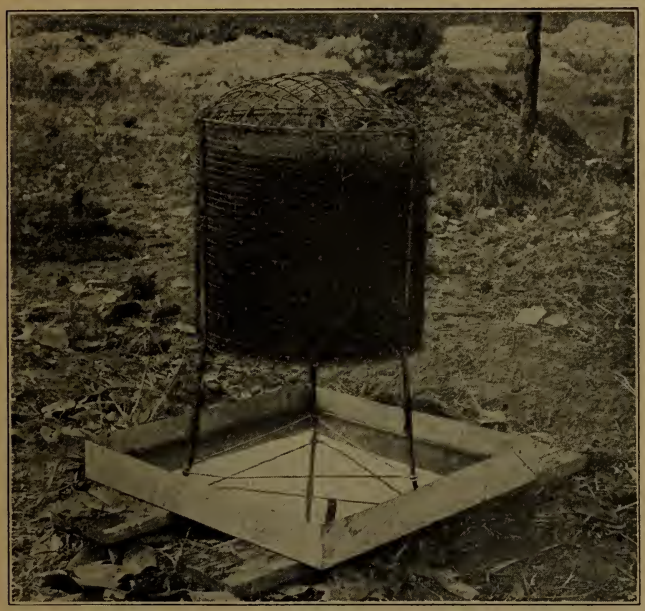

Fig. 10.—Cage for stable manure which automatically rids itself of maggots.

On account of the migratory habits of the full-grown larvae, or maggots, which takes them to the bottom of the manure in such a receptacle, especially when the manure is wet, Levy of Richmond proposed a manure barrel with holes in the bottom, through which he found that the full-grown maggots drop and can easily be caught in a large pan of water floating a film of kerosene beneath the barrel. In experiments carried on by the Bureau of Entomology at Washington, it was found that a receptacle made of heavy wire of one-fourth inch mesh, supported by a light wooden

framework, standing on legs 8 inches high, with a large galvanized iron pan beneath it, operated almost perfectly as an automatic eliminator of fly larvae. The stable-manure was placed in this container and sprinkled with water. Eventually it was shown that more than 98 per cent. of the fly larvae destroyed themselves by burrowing down and dropping into the pan (see Fig. 10). This idea was tested on a practical scale at the Maryland Agricultural College during the season of 1914. A platform was constructed large enough to hold the accumulations of manure for eight days. It rested on a concrete base tilted in such a manner that the drippings were discharged into a barrel set in the

Fig. 11.—Structure for the automatic removal of fly larvae from the manure pile.

ground near one end. The details of the construction are made clear from the accompanying figure No. 11. The piling of the manure was begun at the far end of the platform and the mass kept moist from day to day by pumping the liquid from the barrel which has been mentioned. After eight days, when the platform was filled, the manure at the far end had discharged all of its flies and was removed and fresh accumulations placed at this end. In this way the daily accumulations were removed to make way for fresh manure after they had been on the platform for eight days and discharged the flies. This plan was found to be entirely effective in removing the flies from the manure, and they were drowned in the water into which they fell. The work involved was comparatively simple

and the whole plan economical as well as effective. This will be better even than removing the manure, since it leaves an attractive place for the flies of the neighborhood to lay their eggs. If they had not this manure they would probably find some other place to deposit their eggs.

During the summer of 1914 Mr. Hutchinson of the Bureau of Entomology found that a platform, made of strips of wood set about an inch apart, standing two feet above a concrete floor provided with a drain, formed a very satisfactory device for eliminating the larvae from the manure. No cage was required and the only attention given was to keep the manure moist.

Treatment of the Manure Pile

It is considered necessary to keep manure for a longer or shorter time, even when carried away from the stable, in piles, in order that it may become properly "rotted," and from which it may be taken from time to time as it is needed for successive crops. To abolish these manure piles would be a hardship; to permit them to remain untreated and to give out flies by the millions is a great danger even when they are kept at a considerable distance from houses. It therefore becomes necessary to treat the frequent additions to these piles and even the piles themselves with some substance which will destroy the maggots and which, at the same time, will not injure the fertilizing value of the manure. Many different substances have been used for this purpose and some have been recommended in different publications. The formula consisting of arsenate of soda, 4 pounds, molasses, 2 quarts, and water, 50 gallons, is recommended in several health bulletins; and copperas, or sulphate of iron, at the rate of 2 pounds to a gallon of water for each horse each day is recommended by others.

Arsenite of soda is an active poison and dangerous to have about. Poultry visiting manure piles treated with this substance may be poisoned. Moreover, the arsenic kills the bacteria in the manure.

Copperas kills the bacteria and reduces the fertilizing value of the manure.

During the summer of 1913 extensive experiments were carried on cooperatively by an entomologist, a chemist and a bacteriologist of the U. S. Department

of Agriculture, and these and all of the substances which have been recommended were carefully tested, first for their maggot-killing properties, second for their effects on the chemistry of the manure pile, third for their effects on the bacterial content of the manure pile.

Of all the substances tried, borax showed the most promise from the beginning. The bacterial count was not reduced, but it was found by field experimentation that manure treated with large amounts of borax and then used as a fertilizer had a retarding influence on the growth of plants. Finally in this experimental work the point has been reached where it may safely be advised to use powdered borax weekly at the rate of three-fifths of a pound to eight bushels of manure. This will kill fly-maggots and will not appreciably injure the manure.

Formula of Solution for Destroying Eggs of Flies

Add 0.62 pound of borax, or 0.75 pound of colmanite (crude calcium borate) to every 10 cubic feet (8 bushels) of manure, directly on removing it from the barn, applying it particularly around the outer edges of the pile. A flour-sifter or any other fine sieve may be used for the purpose. Two or three gallons of water are then sprinkled over the borax-treated manure. It is important to make the application to the fresh manure immediately after removing it from the stable, as flies lay their eggs in the fresh manure, and by treating it in this way the hatching of the egg is prevented. The treatment should be repeated with each addition of fresh manure, except where the manure is kept in close boxes, in which case less frequent applications are sufficient.

This same procedure may be used with refuse, garbage and the other manures. It is a good plan, also, to apply borax to the floors and crevices in barns and stables. In addition to its larvacidal action, borax has cleansing powers.

The amount of manure from a horse varies with the straw or other bedding used, but from 12 to 15 bushels of manure a week represent the approximate amount obtained. As borax costs 5 cents a pound in 100-pound lots, it will make the cost of the borax used less than 1 cent a horse each day.

Such a treatment of the manure pile is economical, effective and harmless, and until something better is found the use of borax in this way is advised.

Treatment of Other Breeding Places

Remembering what has been said in the preceding paragraphs about other breeding places and that these include all refuse which tends in any way to fermentation, the plain remedy is to get rid of such refuse, by carting it away, or by burning it, or treating it with kerosene or borax. It is impossible to leave trash about and avoid flies. Clean up everywhere.

RULES FOR THE PREVENTION OF FLIES

Keep the flies away from the sick, especially from those ill with contagious diseases. Kill every fly that strays into the sick-room. His body may be covered with disease germs.

Do not allow decaying material of any sort to accumulate on or near your premises. All refuse which tends in any way to fermentation, such as bedding, straw, paper-waste and vegetable matter, should be disposed of or covered with kerosene oil or dusted with borax.

Screen all food, whether in the house or exposed for sale.

Keep all receptacles for garbage carefully covered and the cans cleaned.

Keep all the stable-manure in a vault or pit, or in a wire cage as shown in this pamphlet, but if necessary to keep in piles, treat with borax weekly at the rate of three-fifths of a pound to eight bushels of manure.

See that your sewage system is in good order; that it does not leak; is up to date, and not exposed to flies.

Burn or bury all table refuse or treat it with borax.

So long as there are flies about, screen all windows and doors, especially in the kitchen and dining room.

If you see flies you may be sure that their breeding-place is at no great distance. Search for it and destroy it.

If there is no dirt or filth, there will be no flies.

A MOVING PICTURE.

Place.—Sidewalk display of food products.
Time.—Midsummer.
Personnel.—Flies, pedestrians, customers, etc.

ACT I.

Two swarms of flies are breakfasting on a bright summer morning on two delectable dishes in front of the grocer's store—one is a fresh pile of horse dropping; the other a generous expectoration of tuberculous sputum just deposited by a gentleman who has recently "come West for his health." Several pedestrians pass, which alarms the aforesaid flies, and they immediately arise, to settle back on the first thing to attract their attention, which seems to be the attractive food products just put out on the sidewalk by the grocer, and, with legs, wings and mouth reeking with filth and tubercular germs, they voraciously attack their second course.

ACT II.

Infested food eaten by a man who was "run down" by a "bad cold."

ACT III.

Another **case** of tuberculosis reported to the department of health.

ACT IV.

Another **death** from tuberculosis reported to the department of health.

CURTAIN.

SWAT THE FLY!

(Kansas State Board of Health)

"THE SONG OF THE FLY."

The Butterfly's a free-lance and the Bee a buccaneer,
And the Dragonfly's a pirate lurking in each hidden nook;
The Katydid's a gossip, clacking loud for all to hear,
But—the Little Harmless Housefly—I'm the villian of the book.

My life begins in filth-piles which the shiftless men ignore;
I fatten on the loathsome mess until my wings appear;
Then out into the daylight, ubiquitous I soar,
With liberty unbounded on my murderous career.

I love to haunt the stable—which they never think to screen,
Or spend a crawling hour in the open-work latrine,
Then hasten to the kitchen with a stimulated zest
And sample every dish to find which one I like best.

I feast in sick-room vessels—pause to taste a pool of spit.
Explore a pauper's festering sores—torment a mangy pup,
Then with my deathly freighted toes my whilom way I flit
To pantry or to dining-hall or to a drinking-cup.

I dabble o'er a carcass—its putrescence is a treat;
Then away to taste the sweetness of a sleeping baby's lip,
I'm an instrument of murder and my weapons are my feet,
For I leave my trail behind me whereso'ever I pause to sip.

So childless breasts and aching hearts come stalking in my wake,
And graveyards yawn expectantly because men let me live;
From high and low, from rich and poor, my ghastly toll I take;
To age nor youth nor helpless babe no quarter do I give.

So it's ho! for hall and hovel—you may find me everywhere,
Man's menace from the moment when he draws his natal breath;
Created in a dung-hill, yet I come to cleave the air—
The Special Agent of Disease—the Courier of Death.

—N. C. HEALTH BULLETIN.